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THE FOOD OF THE ALASKA FUR SEAL

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THE FOOD OF THE ALASKA FUR SEAL [1]

By Victor B. Scheffer, Biologist, Fish and Wildlife Service
United States Department of the Interior

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Introduction

In response to many inquiries we have prepared a summary of current information on the food of the fur seal, Callorhinus ursinus (L.). For the most part, this information is taken from published accounts of naturalists who have studied the fur seal in the North Pacific Ocean and Bering Sea during the past fifty years (see bibliography).

Commercial fishermen observe fur seals by the thousands feeding and resting in coastal waters in winter and spring. Not infrequently they find the body of a seal tangled in a fish net. These men who make their living from the sea quite naturally raise the questions, "What are the seals eating and to what extent do they compete with us in the taking of commercially important fish?" As a spokesman for the fishermen of British Columbia, a member of the Canadian parliament recently stated "(herring and pilchard) are the type of fish which these marauding animals devour in great quantities. I say that the figures show that there has been a distinct reduction in the number of fish of that type caught in those waters in recent years, in spite of the improved equipment for catching fish of that type. I am not suggesting that the increase in the fur seal herd is the only cause of the reduction in the number of herring that are caught, but I claim that it is very much one of the contributing causes" (Canada, House of Commons, 1948, p. 3329).

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It is our opinion that the seals do more good than harm. That is, they produce annually $4 million worth of fur, seal meal, and seal oil, representing more than the value of the fish and shellfish which they consume. The main purpose of the present paper is to lay before you in concise form the known information on the food of the fur seal so that you can draw your own conclusions as to the economic status of the herd.

There are three common ways of finding out what a wild animal eats: First, watching him in the act of eating, second, examining his stomach contents, and third, examining his droppings. One can also gather evidence, though indirectly, by feeding the animal in captivity; that is, one can offer him food and keep a record of what he accepts and how much he eats. Examining the droppings, a useful technique in the study of many wild animals, is infeasible in the case of the seal. When the seal is on land and available for study, his alimentary tract is generally empty (fig. 1).

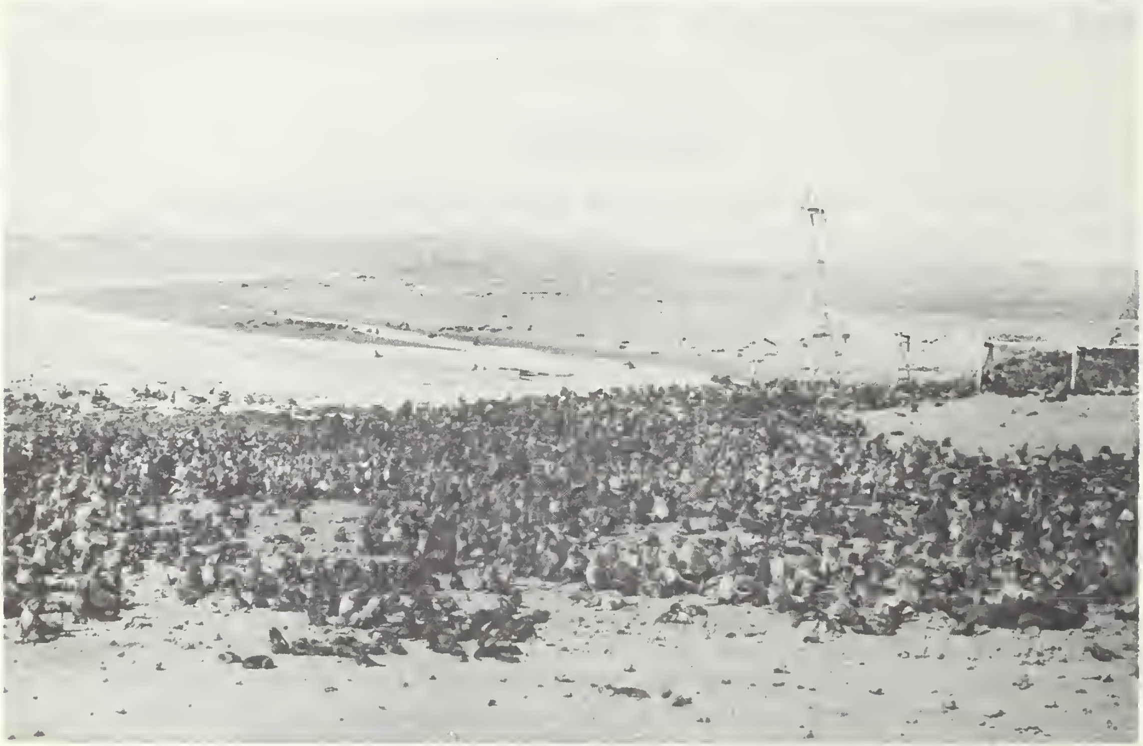

Figure 1.— Fur seals on their breeding grounds, St. Paul Island, Alaska, 16 July 1948. Most of the seals shown here are breeding females. Several dozen small black pups are grouped at the left foreground, while others are scattered among the females. On the distant sandy beach several hundred bachelor seals are resting. By means of the tower and elevated walk the biologists study the seal herd in safety.

Feeding Habits

In searching through the literature we find that scarcely anyone has seen a fur seal feeding in the wild. The reason is, of course, that seals feed on the high seas where they are difficult to watch.

Joseph T. Barnaby, biologist in charge of experimental gill-netting operations in the Bering Sea, said that on several occasions in 1940 he watched fur seals taking salmon from a net. A seal would seize a fish in its mouth and shake it vigorously, breaking off chunks of a size that could be swallowed.

Fur seals have been captured near the floor of the sea at depths down to 240 feet, which suggests that they feed to a certain extent on bottom fish (Scheffer, 1946). Again, the finding of abundant "seal fish" remains in stomach contents (Table 2) indicates that seals may obtain part of their food in deep water. The "seal fish", originally named *Therobromus callorhini* Lucas, is known to be a species of *Bathylagus*, a deep water fish (Chapman, 1943).

William R. Stedman, a fisherman of nearly forty years' experience in Alaska, says that he occasionally catches fur seals on his halibut lines. He recovers them from lines as deep as 100 fathoms (600 feet). Mr. Stedman assumes that, when the seals take the bait in very deep water, they do so while the line is being let out.

To this evidence is opposed the observation that cod and halibut, both of them bottom-feeding species of great abundance in Alaska, are not conspicuous in the stomach contents of fur seals (Table 2). Furthermore, Aleut natives regularly take halibut within five miles of the Pribilof beaches where nearly a million mother seals are feeding their nurslings throughout the summer months, and where one would expect to find a depleted population of fish.

For the first four months of his life the fur seal pup feeds greedily on milk (fig. 2). His weight at birth in July is about 11 pounds, while at weaning time in November it is 35 pounds. (The mean weight of 20 newborn, or about to be born, males is 12.11 pounds; of 16 females, 10.63 pounds. A male and female collected at random on November 17, 1947, weighed 38-1/2 and 35 pounds.) The pups are believed to nurse at rather long intervals. Feeding may be several days or a week apart. While the mother at first nurses her own young and none other she may, later in the summer, nurse a hungry pup from another family.

The evidence on this point, however, is presumptive. Exactly how and where the pups are weaned is a mystery. From what little we know, the pups and the mothers leave the islands independently and at the rate of a few thousands a day, in the months of October, November, and early December. Perhaps the young ones make the change abruptly from a milk to a fish diet or, less likely, they learn before they are fully weaned to catch fish.

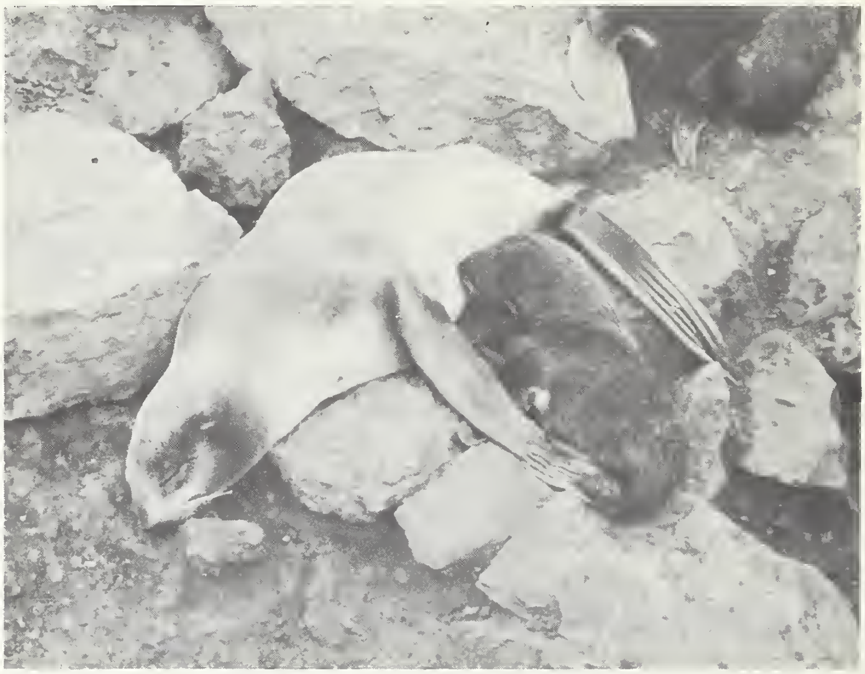

Figure 2.— A seal pup getting milk from its sleeping mother. The mammary gland is very large, extending from the abdomen around the sides of the body almost to the back. The four nipples are on the abdomen. St. George Island, Alaska, 21 July 1946. Photo by Georges Prefontaine.

Stomach Contents

Our knowledge of the food of the fur seal is based almost entirely upon stomach analyses of animals killed by professional sealers previous to the Fur Seal Treaty of 1911, or by Indians. (Aborigines of North American coast have the hereditary privilege of killing fur seals, provided that they use primitive weapons and boats.) Some 1,300 stomachs, about 60 percent of them empty, have been studied. With few exceptions these were collected near shore during seasons of good weather and thus they poorly represent the diet of the fur seal over its entire, far-flung range and throughout the year. For example, only four stomachs from south of the Washington coast have been examined, yet we know that seals by the tens of thousands habitually enter the southern waters in winter. As a matter of fact, nothing is known of the food habits of seals in the winter months anywhere on their range. The food of seals on the high seas, five hundred to a thousand miles from land, has not been determined. (Members of a Fish and Wildlife Service research party, crossing the North Pacific Ocean from Dutch Harbor to San Francisco in December 1948, found that the seas were too rough to permit seal hunting.)

While the 1,300 stomachs now collected are not as good a sample as one might wish, they do demonstrate the food habits of seals along the continental shelf during the fishing season for halibut and other commercial species.

Two common ways of describing the stomach contents of an animal are, first, to show the percentage composition (by weight or volume) of the contents and, second, to show the frequency of occurrence of various food items. About half of the available data on fur-seal stomach contents are expressed in terms of occurrence, which is unfortunate because this is the poorer means of expression. Only three tabulations giving percentage composition have come to our attention.

Clemens and Wilby (1933) give the percentage composition of the contents of 25 stomachs but do not state the volumes of the contents of the individual stomachs, so that it is impossible accurately to weight the various items. For the summary which we have made in Table 1, we have assumed that all 25 of the stomachs contained equal quantities. While obviously not true, it is the closest approach that the data permit. Clemens and Wilby do not give the number of empty stomachs, although they state that only well-filled stomachs were accepted by the fisheries officer.

Clemens, Hart, and Wilby (1936) have made the greatest single contribution to knowledge of fur seal food habits. Their paper shows the quantity of stomach contents, percentage composition of food items in each stomach, and number of empty stomachs.

May (1937) presents his findings for 39 stomachs containing food, gives the number of empty stomachs, and the percentage composition of those with food, considered collectively.

Table 1 shows with little room for doubt that herring is the principal food of the fur seals during their northward migration along the coast in spring. Chapman (1941, p. 6) states that

> "Along the Pacific Coast of North America the herring-like fishes normally yield, by weight of their product, more than all the fisheries put together. The California sardine alone produces more than any other single fishery of the United States. These species at the same time are perhaps the most important forage fishes for the other denizens of the ocean. Whales, porpoises, fur seals, hair seals, sea-lions, chinook and silver salmon, tuna, shark, sea-gulls, and other carnivorous birds and fishes almost without end are dependent upon them for more or less of their food."

TABLE 1.— Stomach contents of Alaska fur seals taken in coastal waters between Washington and Southeast Alaska in spring and early summer: percentage composition by weight. 1/

Kind of food	Sum of weighted percentages
Herring (*Clupea pallasii*)	72.4
Herring (*Clupea pallasii?*)	6.2
Unidentified animal tissue, mostly fish	4.1
Eulachon	2.3
Salmon, unidentified species	2.1
Pilchard	1.9
Clupeidae?	1.7
Salmon, coho	1.5
Salmon?	1.5
Sand lance	1.4
Squid	1.1
Salmon, pink	0.8
Salmon, spring	0.8
Rockfish (*Sebastodes* sp.)	0.8
Hexagrammid	0.6
Murrelet, marbled	0.6
Other minor items of total weighted percent about	0.2
	100.0

1/ Based on 672 stomachs containing food examined by Clemens and Wilby, 1933; Clemens, Hart, and Wilby, 1936; and May 1937 (see bibliography, page 15). We have retained the authors' terminology.

In terms of money value the herring fishery is relatively unimportant. Virtually all herring are converted into low-priced meal and oil rather than into food for human consumption. Thus the competition of the seal herd with man for the herring harvest is not serious.

We have prepared another summary (Table 2) to demonstrate the variety of things eaten by fur seals. We have excluded parasitic worms, seaweeds, stones, and other non-food items that occasionally appear in seal stomachs. Heading the list in importance are two species of squids. A word of caution is necessary at this point. We feel certain that many reports of squids are based on beaks rather than bodies. Squid beaks are tough, horny, and sickle-shaped. Resistent to digestive juices, they persist for a long time in the folds of the stomach. What true rank, then, should be given to squids in an array of stomach contents is a matter of personal opinion.

Pollack, the next most common food item, is more important to seals in the Bering Sea than anywhere else. King (1949) found that in exploratory drags made by the trawler *Alaska* in the summer of 1948, about 1,000 pounds of pollack a day were taken during 36 days of fishing.

Clemens, Hart, and Wilby (1936, p. 10) found that the largest numbers of any one food organism in a stomach were: herring 60, eulachon 20, squid 15, coho salmon 3, and rockfish 2.

Lucas (1899, p. 63) found remains of five good-sized pollack in one stomach· remains of 41 in another; and remains of 139 seal fish (Bathylogus) in another. One stomach contained 210 squid beaks, probably the left-over scraps of several meals.

We have mentioned the rapid growth rate of the pup. At birth, the stomach capacity of a ten-pound pup is nearly a quart. (The stomach of two pups examined on July 28, 1949, contained 725 and 730 millileters (24 ounces) of milk. The stomach of another, examined on July 16, 1949, had a capacity of 34 ounces when filled with tap water at moderate pressure.) Compare this with the stomach capacity of a seven pound, newborn human infant, about one or two ounces, and up to six ounces within a fortnight.

The stomachs of fur seals often contain stones, some of several pounds in weight (Emery, 1941; Lucas, 1899). We believe that young seals casually pick up stones from the beach, and that older seals acquire them by eating bottom fish (Thompson, 1919).

TABLE 2.— Frequency of occurrence of food items in stomachs of Alaska fur seals

			Analysis of preceding column by locality and authority 1/												
		Number of stomachs in which food items occurred	Bering Sea	Gulf of Alaska			West coast Vancouver Island			Lapush, Wash.			Depoe Bay Oregon	Calif.	
Reported name	Other name		(g)	(a)	(g)	(h)	(c)	(e)	(d)	(b)	(j)	(h)	(i)	(f)	(k)
SQUIDS	*Gonatus fabricii*; *Loligo opalescens*	307	211	5	36	1	21		8	1	21	2	1		
POLLACK	*Theragra chalcogramma*	256	254		2										
HERRING	*Clupea pallasii*	221					178		17		15	10	1		
HERRING ?	Probably herring	23				12						10	1		
CRUSTACEA	*Thysanoessa spinifera*, etc. 2/	156				2	147			1	1	5			
SEAL FISH	*Bathylagus* sp.	107	107												
SALMONS	*Oncorhynchus*, five species	52	25	2	2		14		9						
SALMON ?	Probably salmon	7					7								
EULACHON	*Thaleichthys pacificus*, smelt	31					30		1						
ROCKFISHES	*Sebastodes* spp.	? 31		10	?20		1								
LAMPREY	*Entosphenus tridentatus*	11	10								1				
GREELING	Family Hexagrammidae	7					7								
COTTOID	Sculpin, bullhead	6	5						1						
PILCHARD	*Sardinops caerulea*, sardine	6							6						
OSMERID	Smelt-like fish	5					5								
SAND LANCE	*Ammodytes personatus*	5					5								
STICKLEBACK	Family Gasterosteidae	4		1			3								
FLOUNDER	Family Pleuronectidae	3					3								
GASTROPOD	Sea snail	3					3								
COD	Family Gadidae	3	2				1								

WOLF FISH	Anarichas lepturus	2		2												
LING	Ophiodon elongatus ?	2			2											
OCTOPUS	Family Polypodidae	2		2												
MURRELET	Brachyramphus marmoratus	1						1								
BIRD	Unidentified; shearwater ?	1													1	
SHAD	Alosa sapidissima	1									1					
HAKE	Merluccius productus	1								1						
BLENNY	Family ?	1						1								
ROUGH SOLE	Lyopsetta exilis; flatfish	1						1								
SAURY	Coleolabris saira	1														1
GRENADIER	Macrurus acrolepis	1							1							
NUDIBRANCH	Sea slug	1						1								
UNIDENTIFIED	Usually fish or squid flesh	71		2	18	12		30			2		8			
EMPTY		?558		?	66	?	47	400		?	3	15	27			
NUMBER STOMACHS REPORTED EXAMINED		1,295	3/	373	104	36	3/59	593	1	25	3/5	41	54	2	1	1

1/ Authorities; for full titles see bibliography, page 15.

(a) Alexander, A. B., 1892; (b) Bonham, Kelshaw, 1941; (c) Clemens, W. A., J. L. Hart, and G. V. Wilby, 1936; (d) Clemens, W. A., and G. V. Wilby, 1933; (e) ibid., 1946; (f) Huey, Laurence M., 1942; (g) Lucas, F. A., 1899; (h) May, Franklin H., 1937; (i) Neff, Johnson A., 1947; (j) Schultz, Leonard P., and A. M. Rafn, 1936; (k) Sperry, Charles C., 1949.

2/ Euphausids, mysids, and crabs; small in total bulk; chiefly fragments from fish stomachs.

3/ Or more, since only full stomachs were reported. From the data given, we estimate that about 60 percent of the stomachs were empty.

A seal pup taken on the Pribilof Islands and held in captivity voided a volcanic pebble that had presumably remained in its alimentary tract for at least 57 days (Bonham, 1943).

The question is raised from time to time, "Are seals able to digest fish bones or do they regurgitate them?" We cannot answer this fully, although we suspect that a seal is able to digest the greater part of any fish that it eats. Seals in captivity do not normally regurgitate. Bones in all stages of digestion appear in stomach contents of seals killed at sea. It is likely, however, that a seal will regurgitate portions of a large fish like the "pollack 18 inches long bolted head and all" mentioned by Lucas (1899, p. 65).

The stomachs of seals on the Pribilof Islands are nearly always empty. The seals digest their recent meal before leaving the water. In July 1944, we cut open the stomachs of 50 known-age three-year-old males on St. Paul Island. The contents were: ascarid worms in 48 stomachs, average 12 (1-50); stones in 16 stomachs, average 7 (1-34); shell fragments in 12 stomachs, average 7 (1-37); and fish eye-lenses, 1 in 1 stomach. While we have examined relatively few stomachs of lactating females on land, we suspect that most of them are empty. Supporting evidence is the scarcity of excrement on the breeding grounds.

The large capacity of the fur seal alimentary tract (as compared, let us say, with that of a dog) suggests that the seal is well equipped to feed heavily in a school of squids or fish, then fast for a considerable length of time. For example, we examined the stomach of an eight-year male, a fasting bull weighing 405 pounds. His stomach, when filled with tap water at ordinary pressure, weighed 44 pounds and had a capacity of 39-1/2 pounds (fig. 3). We measured the entire alimentary tract of another animal, a fasting nine-year male 196 centimeters (77 inches) in length, weighing 415 pounds. It was 3,788 centimeters, or 124 feet, in length.

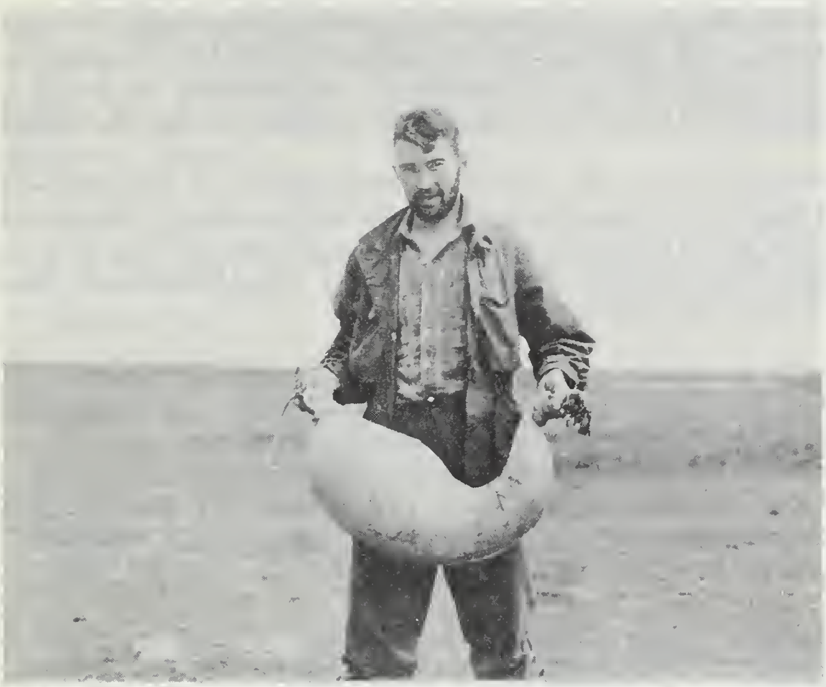

Figure 3.— The stomach, filled with tap water in order to show its capacity, of a fasting, adult, male fur seal. Weight of seal, 405 pounds; weight of water, 39-1/2 pounds; St. Paul Island, Alaska, 2 July 1949.

Food Habits in Captivity

The Balboa Park Zoo in San Diego, California, has successfully held fur seals in captivity for as long as seven years. Harold L. Norris, in charge of the commissary there, says that each subadult seal eats ten or twelve pounds of fish a day. The seals are especially fond of mackerel (*Pneumatophorus diego*). They also eat barracuda (*Sphyraena argentea*), yellowtail (*Seriola dorsalis*), and sardine (*Sardinops caerulea*), although they seem to grow tired of the latter three species within a few days. In general, the seals relish firm, small-scaled fish. They have been known to refuse squid and shark flesh on several occasions. (In the wild, of course, they eat a great many squids.) Four young seals of mixed sexes, weighing 52-1/2 to 65 pounds, were each eating from 6 to 6-1/2 pounds of fish a day in the winter of 1947-48.

On the Pribilof Islands, October 5, 1948, we captured two fat and healthy fur seal pups about three months old. On arrival at the Balboa Park Zoo on October 17 one of them, an albino female, weighed 19 pounds. The other, a near-albino male, weighed 23 pounds. The average daily food consumption of each pup rose from 2-1/4 pounds at the start of confinement to 6-2/3 pounds by May 4, 1949 (Arthur L. Kelly, in letter of May 7, 1949).

In the Woodland Park Zoo, Seattle, Washington, a two-year-old male seal "fed heavily for a 47-day period during which its average daily consumption of fish was 5.73 pounds or 14 percent of its weighted average body weight" (Bonham, 1943). At the end of the period the seal died of unknown causes.

We have made an attempt to estimate the amount of food eaten by the fur seal herd in the course of a year. It is obvious of course, that an estimate of this kind must be based on speculative as well as established data. Nevertheless, we have a better basis for estimating the food requirement of the fur seal herd than for estimating that of perhaps any other wild mammal population. Let us consider briefly the probable size of this requirement.

1. Starting with the information that a one-hundred pound seal can be maintained in good health in captivity on five or ten pounds of fish a day, let us assume that a seal in the wild will eat one-fifteenth of its body weight in a day. Further evidence, more difficult to interpret, is furnished by stomach examinations. Clemens, Hart, and Wilby (1936, p. 10) state that "the largest amount of food found in the stomach of any seal was 130 ounces (8.12 pounds) in a large female taken on May 20. The average amount of food found in the 135 stomachs considered as full was 35 ounces (2.1 pounds)". We have mentioned a stomach capacity of 39-1/2 pounds in a fur seal weighing 405 pounds, representing a ratio of about 1/10.

2. The size of the seal herd, by age and sex components, has been estimated by Kenyon (1950). His data are given in Columns A and B of our Table 3.

3. The weight of a seal of known age and sex has been fairly well established through studies of branded animals (Column C, Table 3).

4. The total weight of the seal herd can now be estimated (Column D).

5. (The weight of the herd) x (365/15) is 946,395 tons.

6. Let us deduct 20 percent to account for the facts that, first, the harem bulls, and probably certain other classes, do not eat during the breeding season and, second, about half of the pups die before August 10 of the following year. We thus arrive at an estimate of 760,000 tons of food consumed in the course of a year.

One could proceed further to show that the pup class gains about 5,000 tons of weight during the nursing period. It is sufficient to remark that the statistics of the fur seal herd are impressive.

TABLE 3.— Estimated weight of the Alaska fur seal herd, by classes, as of August 10, 1950

A	B	C	D
Class	Number of seals in class	1/ Mean weight of seal, in pounds	Weight of class in pounds
Pups	470,000	20	9,400,000
Breeding cows	470,000	70	32,900,000
Non-breeding cows	120,000	65	7,800,000
Harem bulls	11,300	450	5,085,000
Other bulls	4,000	400	1,600,000
Yearling females	120,000	32	3,840,000
Yearling males	120,000	38	4,560,000
2-year-old females	90,000	40	3,600,000
2-year-old males	90,000	60	5,400,000
3-year-old males	14,000	68	952,000
4-year-old males	7,700	90	693,000
5-year-old males	7,000	125	875,000
6-year-old males	6,000	180	1,080,000
Totals for seal herd	1,530,000		77,785,000

1/ From Kenyon, 1950.

SUMMARY

1. About 1,300 fur seal stomachs, 60 percent of them empty, have been examined by naturalists. With the exception of four, the stomachs were collected between Washington and Alaska. Four were collected off the Oregon and California coasts.

2. In order of frequency, the ten most common items in stomach contents are: squid, pollack, herring, crustacea, seal fish, salmon, rockfish, lamprey, greenling, and cod. Herring is the principal food of the seals along the northwest coast in spring.

3. The newborn seal takes up to a quart of milk at a feeding, or about five times as much as a human infant of the same body weight. The young seal nurses on land for about four months, during which time it triples in weight.

4. A seal in captivity will eat about one-fifteenth of its body weight in a day. Stomach contents up to 8 pounds in a seal weighing 10 to 20 times this amount have been reported. In an adult male examined the stomach had a capacity of 40 pounds and the alimentary tract a length of 124 feet. The fur seal herd is believed to consume about 760,000 tons of fish and shellfish in a year.

5. The seal herd produces annually about $4,000,000 worth of fur and byproducts, a return that probably outweighs losses to the commercial fishery as a result of the food habits of the seals.

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